

Expected Contents of
Theory of machines and mechanisms
Academic year **2012-13**

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1) Lubricated kinematic joints [1-Sections 4,6,7,8,9,10,12,14,16,17,21,24]

Types of contacts between kinematic joints; friction in kinematic joints; boundary lubrication; stick slip phenomenon ; work lost in friction; types of wear and Reye's hypothesis; rolling element bearings.

Fluid-film bearings; kinematic viscosity, dynamic viscosity, viscometers, mac coull model, viscosity index, SAE classification.

Fundamentals of viscous flow, hydrodynamic lubrication, continuity equation and Reynolds equation, general thrust bearing theory, parallel-surface slider bearing, fixed-incline slider bearings, fixed-inclined-pad slider bearing, pivoted-pad slider bearing; general journal bearing theory, infinitely wide-journal bearing solution; short width journal bearing theory, design of a fluid film bearing with Raimondi-Boyd's diagrams (numerical example).

Elasto-hydrodynamic lubrication, gas bearings, hydrostatic bearings: pressure distribution and flow, hydrostatic thrust bearings, thrust pad bearings.

Exercise: design of a hydrodynamic journal bearing

Exercise: pivoted-pad slider bearing.

Exercise: fixed-inclined-pad slider bearing.

2) Synthesis of mechanisms [2-Section 8][3-Section 4]

Synthesis of mechanisms; Motion generation: analytical synthesis; Trajectory generation: analytical synthesis; function generation: graphical and analytical synthesis; Motion generation: graphical synthesis (2 or 3 prescribed positions); function generation: graphical synthesis (Grashof rules, pressure angle, drafting machines and pantograph); trajectory generation: graphical synthesis (Eulero-Savary theorem, inflection circle), examples; Robertz's theorem; synthesis by trajectory's atlas; design of a six-link mechanisms for double oscillation.

Exercise: Motion generation: analytical synthesis;

Exercise: Trajectory generation: analytical synthesis;

Exercise: Function generation: analytical synthesis;

3) Gears [3-Sections 8,9]

Friction disks, spur gears, involutes, gear terminology and standards, contact ratio, gear manufacturing, interference and undercutting, nonstandard gears, Helical gears, bevel and worm gears, meshing stiffness, Kuang-Yang model, Measuring gear parameters (Wildhaber, involometry). Elasto-hydrodynamic lubrication in gears, numerical example.

Exercise: nonstandard gears.

Exercise: meshing stiffness.

4) Cam [3-section 6]

Classification of cams and followers, displacement diagrams, graphical layout of cam profiles, kinetostatic analysis, pressure angle, standard cam motion.

Exercises

The exercises must be done in written form. The examination includes exercises.

References:

- [1]. B.J. Hamrock, *Fundamentals of fluid film lubrication*.
- [2] A.G. Erdman, G. Sandor, *Mechanism design, analysis and synthesis, Vol 1*.
- [3] K.J. Waldron, G.L. Kinzel, *Kinematics, dynamics and design of machinery*.

- E.Funaioli, A. Maggiore, U. Meneghetti, *Lezioni di Meccanica applicata alle macchine*, Prima parte, Fondamenti di Meccanica delle Macchine , Ed. Patron, Bologna, 2005.
- E.Funaioli, A. Maggiore, U. Meneghetti, *Lezioni di Meccanica applicata alle macchine*, Seconda parte, Elementi di Meccanica degli azionamenti , Ed. Patron, Bologna, 2009.

In the web:

<http://www.unife.it/ing/lm.meccanica/insegnamenti/meccanica-macchine-meccanismi/>

Other books:

- Jacazio G. e Piombo B., “Meccanica applicata alle macchine”, Voll. I e II, Ed. Leprotto & Bella, Torino.
- Erdman A.G., Sandor G.N., “Mechanism Design, analysis and synthesis”, Vol.1.
- Magnani P.L., Ruggieri G., “Meccanismi per macchine automatiche”, UTET, Torino, 1986.
- Waldron K.J., Kinzel G.L., “Kinematics, Dynamics, and Design of Machinery”, John-Wiley & Sons, 1999.
- Cossalter V., “Meccanica applicata alle macchine”.
- Doughty S., “Mechanics of Machines”, John-Wiley & Sons, 1988.
- Paul B., “Kinematics and dynamics of planar machinery”, Prentice-Hall, 1979.
- Mabie H., Reinholtz C., “Mechanisms and dynamics of machinery”, John-Wiley & Sons, 1987.

Examination

The examination is oral concerning the contents of the course, including the numerical part.